Opportunities and Constraints for Improving Agricultural Water Management in Sub Saharan Africa.
To feed 9 billion people in 2050, we need to produce 70% more food and raise nutrition levels without destroying the environment.

Agriculture accounts for 70% of global freshwater withdrawals.

2 billion people depend on smallholder farming for their livelihoods.

Climate change is largely about hydrological cycle: rainfall and evaporation.

Rising demands are already contributing to:

- land degradation
- loss of ecosystem services
- lack of physical access and infrastructure to access water = water scarcity
WATER SCARCITY AND ACCESS

Sub-Saharan countries have very low water storage per capita
STORAGE AND ACCESS OPTIONS

- **SUBSURFACE**
  - Aquifers (deep, shallow)
  - Soil Moisture
  - Natural wetlands (lakes, swamps etc.)

- **SURFACE**
  - Reservoirs (small, large)
  - Ponds and Tanks

- **Access**
  - Dam outlets, pumps, off-take towers
  - Direct, Buckets, pumps
  - Boreholes, deep / shallow wells, etc
  - Planting crops
  - All of the above

Increasing capital, environmental and social costs and management complexity:

- Increasing storage reliability
RAINFED

• Typified by poor land management and degradation
• Soil erosion 7 ton per hectare per year
• Viscous circle land degradation, lost fertility, poverty, increased agricultural expansion and degradation
• Potential for rainfed agriculture to increase productivity by 3x
• Requires a landscape (watershed) approach
SMALL SCALE IRRIGATION

- Provides incomes when farmers need it most
- Community managed river diversions increase yields and incomes
- Requires investment, capacity and management
SMALL SCALE IRRIGATION

- Small-scale irrigation permits multiple cropping
- SS irrigation boosts farm yields and contributes to poverty reduction.
- Only 5% of Sub-Saharan Africa’s farmland is irrigated

<table>
<thead>
<tr>
<th></th>
<th>Investment costs (USD/ha)</th>
<th>O&amp;M costs (USD/year)</th>
<th>Financed by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buckets</td>
<td>&lt;50</td>
<td>&lt;10</td>
<td>Farmers</td>
</tr>
<tr>
<td>Motor pumps</td>
<td>400</td>
<td>330</td>
<td>Farmers</td>
</tr>
<tr>
<td>Treadle pumps</td>
<td>350</td>
<td>&lt;10</td>
<td>NGOs &amp; Farmers</td>
</tr>
<tr>
<td>Public canal irrigation</td>
<td>10,000</td>
<td>Often not charged, but frequent rehabilitations needed</td>
<td>Gov’t &amp; Donors</td>
</tr>
</tbody>
</table>
Potential to impact millions

SSA: Potential yield improvements from AWM investments

<table>
<thead>
<tr>
<th>Crop</th>
<th>Low-input, rainfed yield (t/ha)</th>
<th>High input, irrigated yield increase (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>1.0</td>
<td>141-195</td>
</tr>
<tr>
<td>Paddy</td>
<td>0.9</td>
<td>270-283</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>0.7</td>
<td>238-251</td>
</tr>
</tbody>
</table>

SSA: motor pumps
- 185 million potential rural beneficiaries
- Net revenues up to US$22 billion/yr.

Tanzania: motor pumps could benefit 2-4 million people (8-12% of rural households).
MULTIPLE USE SERVICES

- Poor households typically use up to 9 different water sources for domestic and livelihood needs.
- Up to 100 litres of water per day are needed within a short round-trip from the homestead for small-scale productive uses to take place at a significant level (scarcity to access)

Improving daily water supply services from 20 to 100 litres per person has the potential to generate an additional annual income of up to $400 per year for a family of five.
Towards Climate and Water Smart Agriculture

AricaRISING

Rainfed Irigated

Innovation Lab SSI

Blue water (surface runoff and groundwater) used to fill the water availability deficit

Green water (rainfall and soil moisture captured in the soil profile)

Continuum of water use from pure rainfed farming to purely irrigated; much farming in East Africa is moving toward somewhere in the middle

Landscape and soils where decisions are made relating to the balance of different ‘waters’ within farming systems
Physical technology based interventions are just part of the picture:
Capacity, business models, financing, governance. In absence not sustainable
TAKE AWAY MESSAGES

• Focus on access to water

• Rural communities reliant on rainfed agriculture need to consider interventions set within a stronger focus on watershed and CC (as opposed to HH and communities)

• Irrigation investments more focus on SSI (and solar?) packages (capacity, servicing, financing, high value crops) need management at watershed

• Irrigation move towards increased water use efficiency towards more sustainable use of water

• Systems approach and thinking, but how to scale out from ‘bright spots’

• There is a need to break down silos of WASH and AWM= SDG6

• Potential beneficiaries 245-280 million people, 58-65% rural poor in SSA

• Research can provide evidence of where and how this can happen
Private Sector: Solar Irrigation Technology

Trevor Forster

Photo credit: Forster Irrigation
PRESENTATION LEARNING OBJECTIVES

• IDENTIFY THE ROLE THE PRIVATE SECTOR PLAYS IN AGRICULTURAL WATER MANAGEMENT
  o COMMERCIAL VS. SMALL SCALE/SUBSISTENCE
  o REALISATION OF THE MDG

• CASE STUDY USING SOLAR POWERED IRRIGATION SCHEMES TO HIGHLIGHT ABOVE ROLE

• HIGHLIGHT THE USE OF TECHNOLOGIES SUCH AS SOLAR SAND ABSTRACTION/ DRIP IRRIGATION IN CLIMATE CHANGE MITIGATION
ECONOMY OF SSF IN AFRICA

- MAJORITY LAND IN AFRICA HELD BY SSF
  Zimbabwe SSF 50% of land, 75% of maize production

- INTENSIVE & EFFICIENT USE OF LAND

- CHALLENGES OF MARKET, INFORMATION & ACCESS OF INPUTS & CREDIT
FORSTER IRRIGATION

• 30 YEARS EXPERIENCE IN IRRIGATION

• 6 YEARS FOCUSED ON SMALL SCALE FARMING (SSF)

• 5 YEARS USING SOLAR TECHNOLOGY
SOLAR PUMPS

- Use of solar panel power to pump water from source into irrigation schemes.
BENEFITS OF SOLAR TECHNOLOGIES

- CLEAN ENERGY
- BASED ON NATURAL CYCLE
- LITTLE MAINTENANCE
- TIME EFFICIENT
LIMITATIONS OF SOLAR TECHNOLOGIES

• COST
  HIGH INITIAL CAPITAL OUTLAY

• UNIFORMITY OF SUPPLY
  8 HOURS PUMPING A DAY, 4 HOURS AT MAXIMUM WATER YIELD (30 000LT A DAY FOR 1HA)

• UNIFORMITY OF DEMAND
  PEAK PUMPING VS PEAK USAGE
DRIP IRRIGATION

- EFFICIENT USE OF IRRIGATION
- EASY TO USE/UNDERSTAND
- CHEAP TO MAINTAIN
- ENERGY EFFICIENT
SOLAR KITS

Solar Kits

- 2 Drinking water taps on bricked pillar with a concrete drainage apron and soak away.
- 5000 litre water tank on 3m stand
- Solar Panels x 18
- Borehole

- 120m x 50m drip kit (6000 m²) complete with filter and 6 isolation valves
- Fallow ground which can be rotated with ground under irrigation without any pipework changes
- 100m x 40m (0.5 ha) Fodder & fruit tree area

Pump is capable of producing an average of 35,000 litres of water:
- Drinking water for 100 people - 2,500 litres
- Drinking water for 100 cattle - 4,000 litres
- Irrigation for 6000 m² drip irrigation - 24,000 litres
- Irrigation for 4000 m² fodder irrigation - 4,500 litres
SUMMARY

• PRIVATE SECTOR NEEDS TO WORK WITHIN POLICY FRAMEWORK

• INVESTMENT IN R&D TO FIND NEW/IMPROVE ON EXISTING TECHNOLOGIES

• USE OF SOLAR POWER, DRIP IRRIGATION AS A HOLISTIC APPROACH TO COMMUNITY DRIVEN IRRIGATION
FURTHER INFORMATION

- www.facebook.com/ForsterIrrigation
THANK YOU!
Irrigation, Gender and Nutrition Linkages: Tapping Irrigation’s Potential for Women’s Empowerment

Elizabeth Bryan, March 15th, 2016
GLEE Workshop, Lusaka, Zambia

Photo credit: IWMI Flickr, Ghana, 2011; Passarelli, Ghana, 2015
Outline

• Motivation: Why gender matters for agricultural water management
• Pathways through which irrigation outcomes influenced by gender
• Preliminary results from ILSSI
• Conclusions and summary
Why Does Gender Matters for Ag Water Management?

- Water is the perfect example to illustrate the gender gap in agriculture
  - Women have different access to and control over water
  - Women have different needs and priorities for water
  - “Double burden” for managing both domestic and productive water
  - Women face constraints in adopting, using and benefitting from water technologies (Van Koppen et al. 2013, Aseyehen et al. 2012, Njuki et al. 2014)
  - In many cases, water technologies and projects do not meet women’s needs and priorities, and fail to address constraints
Closing the gender gap can have positive outcomes

• When women have access to and control over water management technologies, this could lead to:
  • More efficient use – and innovation
  • Positive impacts on household nutrition and health outcomes
  • Women’s empowerment: more time, control over income, decision-making power (Olney et al. 2009; Iannotti et al. 2009; Domenech 2015)
Gender Influences the Pathways through which Irrigation Affects Nutrition and Health Outcomes

- Production pathway
  - Gender differences in crop choices (cash crops vs. homestead gardens)

- Income pathway
  - Who controls the income from sale of crops and from agricultural employment will influence health and nutrition outcomes

- Water supply pathway
  - The extent to which women are involved in the design of irrigation systems may encourage more multiple uses of irrigation water

- Health risks pathway
  - Women are caretakers and play a role in caring for the sick and preventing illness

Source: Domenech 2015; Rosegrant et al. (2009)
Height-for-Age Z-Scores of children under 3 in India varies by the month of their birth

NFHS Data

2005-6
Irrigation also Influences Women’s Empowerment

• Risk that irrigation widens the gender gap if benefits are not equally distributed and/or women adversely affected (e.g. time burden may increase) BUT

• Irrigation projects targeted towards women may contribute to women’s empowerment
  – Eg. Homestead food production program in Burkina Faso increased assets and income controlled by women (van den Bold et al 2013)

• This is not easy!

Photo Source: IWMI, Ethiopia
Why Technologies matter, Ex. Tanz

- Motorized pumps (MP)
- Treadle pumps (TP)
- Buckets, watering cans (MB)

Time spent irrigating (hrs/ha/year)

Source: http://awm-solutions.iwmi.org
FEED-THE-FUTURE INNOVATION LAB FOR IRRIGATION

- Baseline data collection in Ethiopia, Tanzania and Ghana
- Topics of the survey include:
  - Crop & livestock inputs, production and practices
  - Household and women’s dietary diversity
  - Child health, diet, feeding and anthropometry
  - Household shocks, assets, credit
  - Women’s Empowerment in Agriculture Index (WEAI)

Photo Source: IWMI, Ethiopia
## Food security & Dietary diversity in ETH & TZA

<table>
<thead>
<tr>
<th></th>
<th>Ethiopia</th>
<th>Tanzania</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Non-irrigators n=185</td>
<td>Irrigators n=284</td>
</tr>
<tr>
<td>Mean</td>
<td>5.78</td>
<td>4.04</td>
</tr>
<tr>
<td>Household food insecurity access scale, 0-27 [higher means worse]</td>
<td>5.78</td>
<td>4.04</td>
</tr>
<tr>
<td>Female dietary diversity score: number of categories consumed</td>
<td>3.69</td>
<td>3.58</td>
</tr>
<tr>
<td>Household dietary diversity: number of food categories consumed</td>
<td>5.69</td>
<td>6.06</td>
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</table>

*Differences statistically significant, except diff FDDS in Ethiopia*
ILSSI is using the Women’s Empowerment in Agriculture Index (WEAI) as their survey tool. The WEAI measures women’s empowerment across five domains (5DE) of empowerment to the right and the Gender Parity Index. Both of these scores are weighted and aggregated to create the WEAI, which is on a scale from zero to one, with higher values indicating greater empowerment. ILSSI is using a modified WEAI to include more details on irrigation.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Indicator</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Production decision-making</td>
<td>Input in productive decisions</td>
<td>1/10</td>
</tr>
<tr>
<td></td>
<td>Autonomy in production</td>
<td>1/10</td>
</tr>
<tr>
<td>Access to productive resources</td>
<td>Ownership of assets</td>
<td>1/15</td>
</tr>
<tr>
<td></td>
<td>Purchase, sale, or transfer of assets</td>
<td>1/15</td>
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<tr>
<td></td>
<td>Access to and decisions on credit</td>
<td>1/15</td>
</tr>
<tr>
<td>Control over use of income</td>
<td>Control over use of income</td>
<td>1/5</td>
</tr>
<tr>
<td>Community leadership</td>
<td>Group member</td>
<td>1/10</td>
</tr>
<tr>
<td></td>
<td>Speaking in public</td>
<td>1/10</td>
</tr>
<tr>
<td>Time allocation</td>
<td>Workload</td>
<td>1/10</td>
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<tr>
<td></td>
<td>Leisure</td>
<td>1/10</td>
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</table>

Source: Alkire et al. (2013).
### Initial WEAI Results from Ethiopia and Tanzania

<table>
<thead>
<tr>
<th>WEAI</th>
<th>Irrigators</th>
<th>Gender Parity Index</th>
<th>Non-irrigators</th>
<th>Gender Parity Index</th>
<th>Contributors to disempowerment</th>
</tr>
</thead>
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<td></td>
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<tr>
<td></td>
<td>Ethopia</td>
<td>0.82</td>
<td>0.90</td>
<td>0.85</td>
<td>0.91</td>
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<tr>
<td></td>
<td>Tanzania</td>
<td>0.88</td>
<td>0.96</td>
<td>0.86</td>
<td>0.92</td>
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<td></td>
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<td></td>
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<td></td>
<td>Group membership</td>
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<td>Leisure time</td>
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<td>Speaking in public</td>
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<td>Leisure time</td>
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<td>Speaking in public</td>
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<td></td>
<td></td>
<td></td>
<td>Autonomy in production</td>
</tr>
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</table>
### DECISION-MAKING ON IRRIGATION IN ETHIOPIA

<table>
<thead>
<tr>
<th>Women’s Responses: Ethiopia</th>
<th>How much input did you have in making decisions about...</th>
<th>How much input did you have in decisions on the use of income generated from...</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Irrigated food crop farming</td>
<td>Irrigated cash crop farming</td>
</tr>
<tr>
<td>No Input</td>
<td>0%</td>
<td>2%</td>
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<tr>
<td>Input into very few decisions</td>
<td>14%</td>
<td>15%</td>
</tr>
<tr>
<td>Input into some decisions</td>
<td>52%</td>
<td>53%</td>
</tr>
<tr>
<td>Input into most decisions</td>
<td>23%</td>
<td>16%</td>
</tr>
<tr>
<td>Input into all decisions</td>
<td>11%</td>
<td>15%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
## Decision-Making on Irrigation in Tanzania

<table>
<thead>
<tr>
<th>Women’s Responses: Tanzania</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How much input did you have in making decisions about...</strong></td>
</tr>
<tr>
<td><strong>How much input did you have in decisions on the use of income generated from...</strong></td>
</tr>
<tr>
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<tr>
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<tr>
<td>Irrigated food crop farming</td>
</tr>
<tr>
<td>Irrigated cash crop farming</td>
</tr>
<tr>
<td><strong>No input</strong></td>
</tr>
<tr>
<td>0%</td>
</tr>
<tr>
<td><strong>Input into very few decisions</strong></td>
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<tr>
<td>9%</td>
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<tr>
<td><strong>Input into some decisions</strong></td>
</tr>
<tr>
<td>23%</td>
</tr>
<tr>
<td><strong>Input into most decisions</strong></td>
</tr>
<tr>
<td>30%</td>
</tr>
<tr>
<td><strong>Input into all decisions</strong></td>
</tr>
<tr>
<td>37%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>
FGDS: QUALITATIVE GENDER-IRRIGATION FIELDWORK

- Sex-disaggregated focus group discussions already conducted in Ethiopia and Tanzania: Ghana scheduled for February
- **Purpose:** to investigate gender dynamics and irrigation technology, in ILSSI treatment and control sites
- FGDs ask questions about gender-based differences in:
  - **Access to technology** (e.g. access to credit, farmer groups, or information required to invest in irrigation technology?)
  - **Use of technology and technology preferences** (e.g. what type of crops and irrigation methods are preferred? Is irrigation water used for other purposes? What technology meets these needs?)
  - **Decision-making power** (e.g. over crop and irrigation choice; control over income from irrigated plots)
  - **Impacts and benefits from irrigation** (e.g. time-saving? More nutritious crops? More income?)
SUMMARY

- Men and women have different water needs—water-related practices for CSA may not always be designed with women’s needs in mind (i.e. need for multiple uses, etc.)
- Men and women have different abilities to access/adopt/use irrigation/water management technologies
- Distribution of benefits (and costs) from irrigation are not equal (i.e. women’s work burden may go up while men control income from sale or irrigated crops)
- Without conscious effort to integrate gender, irrigation interventions may exacerbate existing gender inequalities
- However, outcomes (i.e. nutrition, health and women’s empowerment) are likely to be different when women have control over decisions to adopt and use irrigation
THANK YOU!

Source: IWMI.